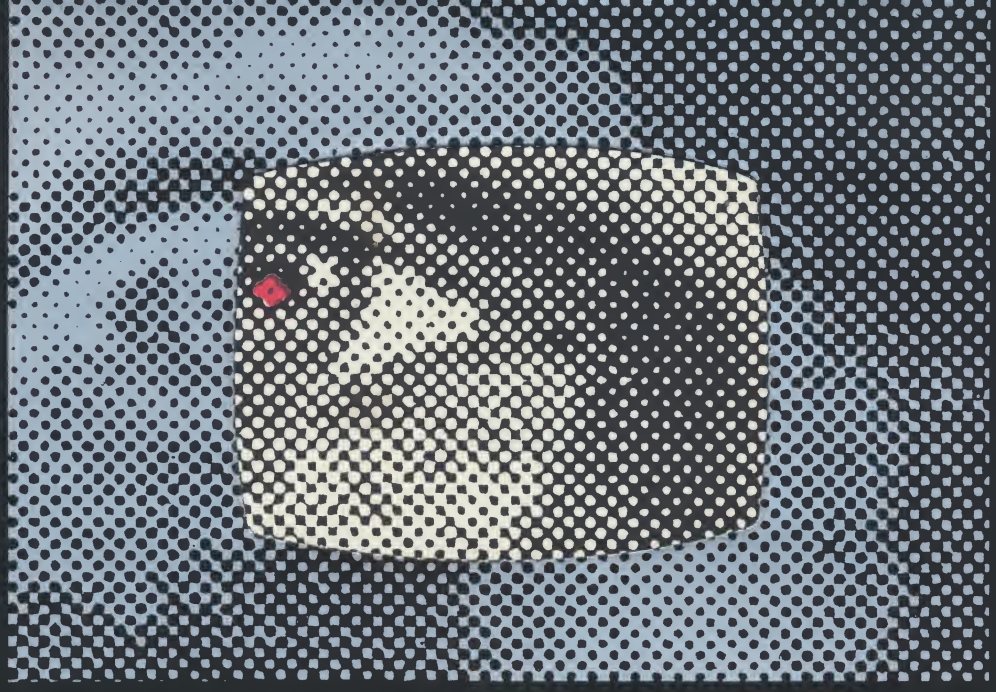

PHOLSICON

"A Startling New System of Control-grid Image Reversal"

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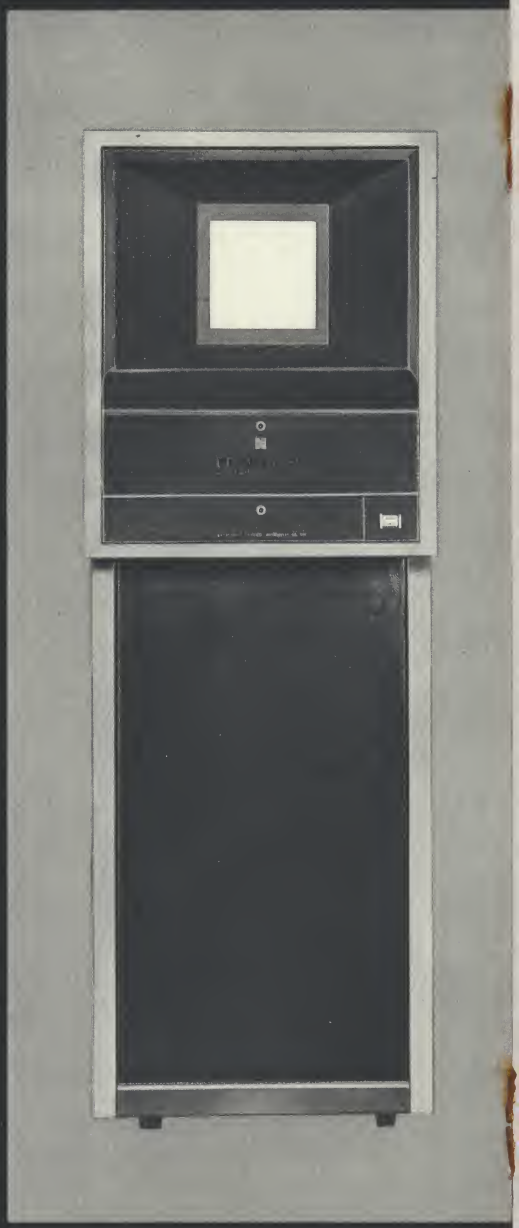
PHOLSICON—
a Solid-State EL-PC Image Converter

PHOLSICON is the invention of Tadao Kohashi, member of the Matsushita Research Institute Tokyo, Inc. This solid-state EL-PC image converter, intensifies and converts the input image to a positive output image, a negative output image or a mixed output image with both negative and positive parts. The characteristic of these output images can be continuously changed by adjusting the two power supply voltages. This means that it is possible to obtain, over a wide range, complete control of the type as well as the gamma and contrast ratio of the desired output image.

This image converter is essentially a solid planer triode with a photoconductive layer sandwiched between an electroluminescent layer and a transparent dielectric layer. The total thickness of all the active layers, exclusive of the glass supporters, is approximately 0.2 mm only. The selection of positive or negative image intensification is obtained by means of the two amplitude and phase-adjustable power supplies and the control-grid embedded in the thin flat photoconductive layer. It intensifies, equally, as well visible light, near-infrared and or X-ray image.

By properly adjusting the amplitude and the phase of the two power supply voltages, the intensified output image may be varied continuously from a positive-intensified reproduction of the original to its negative counterpart, similarly intensified, and vice versa. Gamma and contrast ratio can be controlled simultaneously over a wide range. Since, as input radiation is continuously increased, light output decreases, reaches minimum and increases again, a V-shaped characteristic is produced. This V-shaped characteristic gives "mixed" output image which contains intensified negative and positive parts of the reproduction. An additional advantage of this feature is that it is possible to obtain clearer details and accurate control of the selected portions of the output image.

The excellent image resolution characteristic of the PHOLSICON is based on the grid control action of the parallel fine-wire grid and the lateral photo-



conductivity onto the intensity and distribution of the electroluminescent current (the photoconductivity acts in the plane perpendicular to the input radiation). The resolution is, as a matter of fact, much higher than that expected from the pitch of the parallel fine-wire grid. For example, a 15cm square panel shows an image resolution of 600 lines or more, depending on the angle between the incident pattern and the parallel fine-wire grid.

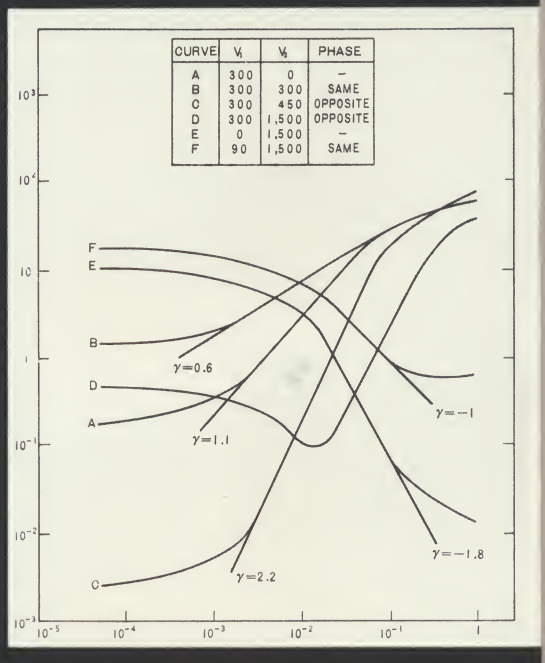
In addition to straight intensification of image projected onto its photoconductive layer, the PHOLSICON is able to convert positive image to negative image and vice versa as well as produce "mixed" output image with emphasis on chosen portion thereof. Because of this versatility, numerous interesting practical applications are foreseen for this image converter. In photography, for instance, the PHOLSICON can be used to directly convert a negative image to a positive image. Since it is possible to regulate the intensification of the resultant image at will or to choose either a negative or a positive as the input image, the PHOLSICON appears to be eminently suitable as a fluoroscope screen.

Since it is as equally sensitive to X-rays as to visible light rays, the applications of the PHOLSICON in the medical X-ray field hold great promises, especially because of its features in X-ray dosage and better image brightness when compared with conventional fluoroscope screen. For industrial X-ray applications, its special V-shaped characteristic should increase its utility value as a working tool.

The response time of the PHOLSICON is limited by that of the photoconductive material used and takes a few seconds. This characteristic should not, however, constitute a shortcoming in such field as radar where rapid response is not imperative and application in this particular field will probably come first.

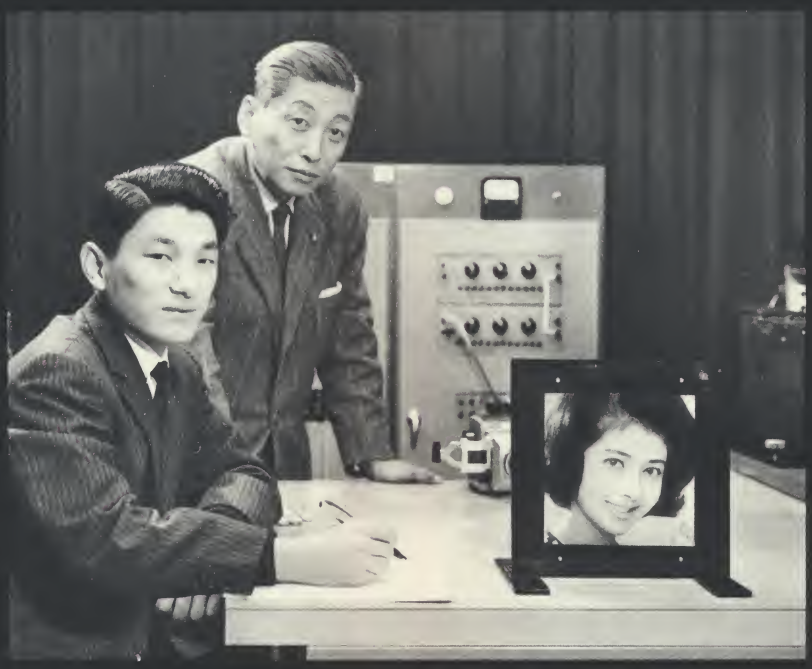
Another interesting application of the PHOLSICON is expected in motion picture film conversion which is also foreseen as a possibility in the near future.

(a)



Typical light input of performance characteristics of PHOLSICON

(e)



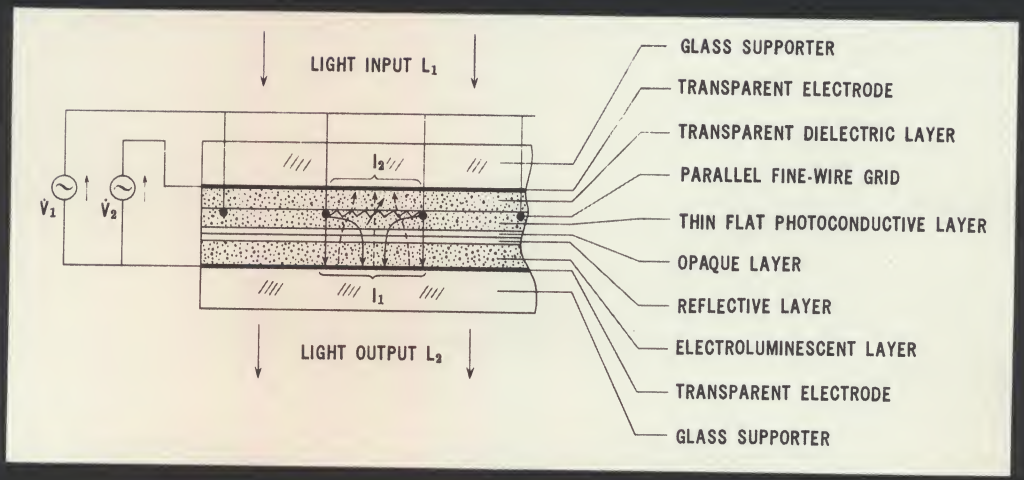
Dr. Koichi Miyaji (right) and Tadao Kohashi (left) carrying out tests on a 17-cm PHOLSICON

(b)

(c)

(d)

Intensified electroluminescent images are continuously changed from positive (a) to negative (e) for a projected positive incident image and conversely (e)→(a), by adjusting two supply voltages.



Cross-sectional view and power supply connections of PHOLSICON

RESEARCH ACTIVITIES

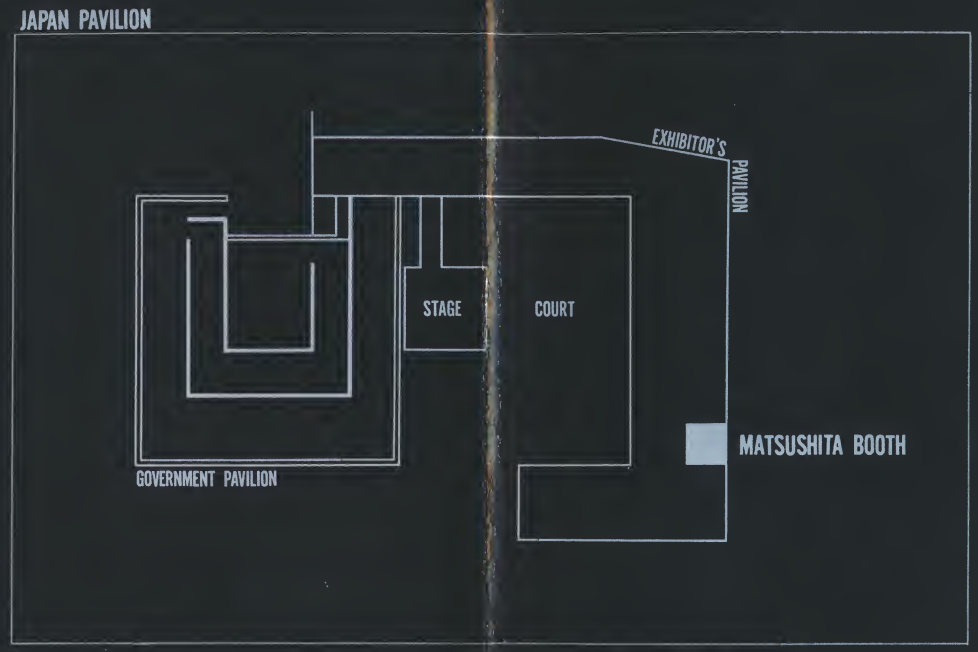
For 37 years since its inception in 1927, the research activities of Matsushita Electric have been consistently directed towards one objective, namely, to probe into the innermost secrets of Nature to find methods and materials which make existing products better for tommorow. How successful Matsushita's researchers have been in this quest is partly exemplified by the fact that Matsushita Electric holds more basic patents and utility patents than any other Japanese manufacturer in the electronics and electric appliance fields.

Today, more than 2,500 scientists and engineers are busily continuing this search for "something better for tomorrow" in one of ten research laboratories situated in various parts of Japan. The photographs on these pages show some of the representative ones. Each laboratory is an autonomous unit with a speciality of its own but works in close collaboration with each other and with the nerve center located at the newly (1963) constructed Central Research Laboratory. To the Matsushita Research Institute Tokyo, located in Kawasaki City, has been assigned the important work of carrying out pure research in the basic science of electronics.

1. CENTRAL RESEARCH LABORATORY, KADOMA, OSAKA
2. MATSUSHITA RESEARCH INSTITUTE TOKYO, INC., IKUTA, KAWASAKI
3. ELECTRONICS RESEARCH LABORATORY, TAKATSUKI, OSAKA
4. TV RESEARCH LABORATORY, IBARAKI, OSAKA
5. PRODUCTION ENGINEERING LABORATORY, KADOMA, OSAKA
6. WIRELESS RESEARCH LABORATORY, KADOMA, OSAKA
7. HOME APPLIANCE RESEARCH LABORATORY, MIKUNI, OSAKA

One of the Matsushita's key factory concentrations, the Kadoma Site includes, among others, the Radio Plant, the Electronic Components Plant and the Construction Materials Plant. The newly built Head Office is seen at the upper left corner of the photograph. The 7-storied building near the Head Office is the newly constructed Central Research Laboratory, the nerve center of Matsushita's network of 10 autonomous research laboratories.

This vast Electronic Plant with 6,000 highly skilled employees is exclusively devoted to the manufacture of such electronic products as semiconductors (20.6%); fluorescent lamps (30.8%); vacuum tubes (20.3%) and TV picture tubes (20.7%). (Percentages based on MITI statistics, April through September, 1963).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Printed in Japan

High Response PHOLSICON

Moving picture image conversion with solid panel has been made practical with the advent of the newly developed High Response PHOLSICON. High Response PHOLSICON is composed of electroluminescent and photoconductive layers and has marvelous characteristics for moving image conversion. This panel has been developed by Matsushita Research Institute Tokyo, Inc., a subsidiary of Matsushita Electric Industrial Co., Ltd., Japan. The previously developed PHOLSICON has a slow response time of more than a few seconds; that is, the output image persists for a few seconds. This slow response time imposed limitations on using PHOLSICON for moving picture image conversion.

But new type High Response PHOLSICON has a response time of 10-100 milli-seconds, sufficiently short for moving picture image conversion without observable persistence of output images.

Moving picture input is converted into various image polarities; positive output image, negative output image, and intermediate output of positive and negative images. Infrared or X-ray image of moving subjects, as well as visible input such as motion picture, are available as the input image.

This moving picture image conversion has been realized by employing a photoconductive material with high response time.

The structure and operating characteristics of High Response PHOLSICON are almost analogous to these of PHOLSICON; image polarity selection, and gamma and contrast ratio control are achieved by adjusting amplitude and phase relation of two a-c driving voltages.

Image quality is excellent; the image resolution for static image is the same as that of PHOLSICON (i.e. $15 \times 15\,cm^2$ panel can display 600 lines or more). For moving picture image, however, the effective image resolution becomes much higher, since eyesight is not fixed to the surface of the panel.

High Response PHOLSICON has a wider field of application owing to its operation for moving images. One example is that motion picture film editors are enabled to convert negative film to positive film directly. Another is medical or industrial X-ray fluorescope screens for moving subjects. Many other interesting applications are foreseen.

BLOCKDIAGRAM OF THE SYSTEM